PLASMA VS. LASER CUTTING:

WEIGHING THE OPTIONS

By Cliff Ankerson

In an economic climate that presents manufacturers with mounting pressures, it's important to know there are options for companies of all sizes that cut metal sheet or plate for their products. Recent developments in plasma and high-definition plasma technologies have made this method cost efficient, particularly for manufacturers that have used or are considering using laser cutting. Now, given the precision and quality that plasma cutting can provide, manufacturers can expect to save money and time using plasma technology on parts that may in the past have required laser cutting.

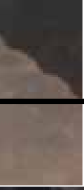
Hypertherm® has performed detailed analyses of these two thermal cutting methods; the graphs illustrate the cost savings of using plasma. Manufacturers will realize savings in both maintenance and operational costs. While use of CO2 lasers is an expensive cutting method, for some processes it may be the only method. But when an engineer or customer allows a manufacturer to recommend and use other means, plasma may prove to be the most economic and efficient option.

For example, when cutting parts with holes or similar features that require extreme accuracy, plasma cutting can now (in some cases) accommodate tolerances once reserved for lasers. Other plasma uses include parts which have no tight tolerance areas such as outline edges or parts for weldments.

While these examples illustrate the advantages of plasma over laser cutting, more difficult situations arise in through-holes, particularly in mounting holes, where hole taper and roundness are more of an issue. With today's high-definition plasma, even these tasks are now within the capabilities of a good plasma cutting machine, fitted with accurate CNC controls and a high-definition plasma torch.

Lasers, with their relatively small heat affected zones (HAZs), have for decades been the mainstays of manufacturing when tighter-tolerance parts are produced with a thermal method. But the relatively high costs of operation and ownership when choosing this method is an important consideration. Lasers come in a variety of shapes and sizes; the CO2 CNC flat-sheet cutting machine is the most common type in most of today's manufacturing environments. High expenditures of energy are required to generate the laser beam, although little actually ends up focused on the cutting operation. Large chillers are needed to remove excess heat — another costly aspect of laser cutting.

While laser operators are aware of the various inefficiencies associated with running an industrial multi-kilowatt laser cutting machine, and no doubt try to optimize their machines, this cutting process only runs in roughly the 3–5% overall efficiency range. Of all the energy required to power the laser, only a fraction of the expended power shows up on work. The other 95% of the energy is removed in the form of heat, never doing any useful work on the part being cut. Some operators may power the resona-



Photos courtesy of Hypertherm

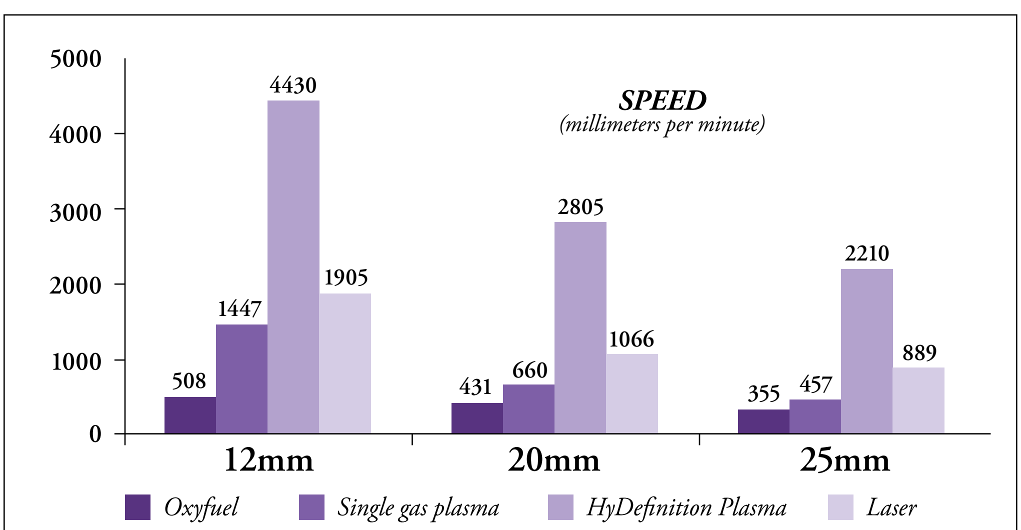
tor up or down depending on production time versus idle time in an effort to improve efficiency. But other operators simply let the resonator operate at full output, regardless of whether or not the machine is actually cutting metal.

A simpler, less expensive alternative is a plasma cutting table. This method is ideal for cutting parts when you don't require such a low heat affected zone (HAZ). Plasma tables can be purchased for less than $50,000, whereas most laser machines — even used systems — often cost at least twice that much. While a manufacturer might be fortunate enough to find a used laser in the $80,000-$125,000 range, the price of a new plasma system, with warranty, is still comparable or less in many cases, and the plasma can often cut thicker material more easily than the laser.

When a plasma device is running, the only significant draw on a manufacturer's electrical system occurs when the plasma torch is actually cutting. The only other significant draw is from the CNC controller and the associated X-Y-Z axes as they move, which is negligible when considering the cost of keeping laser-powered systems running throughout the work day. There's no large chiller to power, no optics, no beam delivery components, and no gases associated with the resonator to develop the laser beam. Overall, the plasma machine is relatively simple, with a few parts on the torch requiring replacement as they wear.

One concern for manufacturers is that with plasma cutting, consumable items in the torch tend to wear more when piercing work is done, as opposed to starting a cut from an edge of a sheet. Processes in manufacturing design that minimize the need for piercing will help alleviate this problem.

To this point we have only been considering the comparison between CO2 lasers and plasma. It should be noted that there is Fiber Laser technology which is significantly different in many aspects from the CO2 resonators. First, they are considered the "state of the art" in today's industrial laser technologies, having much higher overall wall plug efficiency, in the range of 26-30%. They have better coupling or connection to most metals during the cutting operation due to their particular laser wavelength, as opposed to CO2. The result is that typical cutting requires much less laser power to perform cutting in the same thickness and material when compared to a CO2 laser.



Cutting Speed Comparison Chart (courtesy of Hypertherm)

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Fiber laser chillers are also much smaller, physically as well as in the relative amount of heat being removed. This is because fiber lasers develop their laser beam through many small diodes that are only emitting the wavelength desired for cutting metals - thus more effectively using the power being supplied. Also, fiber lasers, deliver their beam through an optical fiber as opposed to conventional beam benders and mirrors. This allows for less energy loss as the beam is transmitted from the resonator to the work piece. One more important consideration is the diameter or size of the focused spot on the work. With fiber laser technology, the output is a very clean, small and focused spot often smaller than produced with other solid state lasers in similar wavelengths such as Nd:YAG flash lamp pumped resonators or diode array resonators. This is a consequence of the diameter, of the fiber which is used to deliver the beam to the focus optic in the laser head. I have seen operations where such small or fine kerf width was produced with fiber lasers that we had to "de-focus" the spot, resulting in a wider kerf to allow the slug to fall from the cut portion of the part for production operation.

While fiber lasers can offer a wealth of astounding features and capabilities, they come with a price tag which has impeded their market acceptance. Therefore, fiber lasers are one of the best technologies on the market today where lasers are actually required for your work. When compared to plasma, again, purchase price is the largest differentiator. Plasma wins when you compare purchase price. As far as cut quality goes, compare on a case-by-case basis and choose the right tool for the right job to keep your costs under control.

Axis International, Inc. builds its CNC plasma cutting machines in Las Vegas, Nevada. To learn more about the company and its line of products, contact Jim Dill at 702-259-6677, and visit the company's website at http://www.axisplasma.com